The American Biology Teacher

Vol. 5 FEBRUARY, 1943 No. 5

The Effect Of The War Upon Our Supply Of Certain Economic Biological Products*

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The topic which has been selected for my presentation this morning is, indeed, a most inviting one, for it concerns a matter which is directly related to the health, comfort and well-being not only of the people of this nation but also to some extent of those of our allies for an indefinite period in the future.

During normal times, little did we think of the possibility of so many regions of the earth, yielding important biologicals such as cinchona and quinine, rubber, coffee, spices, sugar and many drugs and insecticides, becoming so quickly involved in a war destined to obliterate many trade channels and reduce shipping to such an extent in others, as to restrict or eliminate our normal consumption of vital products. We are now cognizant as never before of the fact that we are far from being independent of the rest of the world in the production of those biologicals essential to our modern civilized mode of living.

Among the first of the shortages in these economic biologicals to be felt was that of rubber. We had depended upon the East Indies and Malaya for most of our supply of this product and had not accumulated a sufficient stock pile of it by the time the Japanese had seized those countries. On July 1, 1942, this country had on hand a stock pile of 578,000 tons of rubber. It has been estimated that 842,000 tons of this product would be required for military and other essential demands with no allowance for tires for passenger automobiles between July 1, 1942, and January 1, 1944. The estimated imports from the *Hevea* plantations in South America and to a small extent from *Landolphia* plants of West Africa and other natural rubber sources

* Presented before The New England Biological Association, at Boston, Massachusetts, October 24, 1942.

is 53,000 tons. This means that 211,000 tons of synthetic rubber must be produced before January 1944 unless the South American rubber supply can be materially increased.

Before the present war we consumed over one-half of the world's supply of coffee, most of our supplies coming from Brazil, with lesser amounts from Central American countries, Venezuela, Colombia, Puerto Rico, Haiti, Arabia, Abyssinia, Liberia, Mexico and the Philippines. Sufficient is now available in the Americas for our normal consumption but our supply has been reduced to about 60 percent of the normal quota owing to the need of shipping space for war materials.

Prior to the first World War, this country was largely dependent upon the drug, chemical and dye industries of Europe for its supply of most of these products. As world trade became disrupted a serious shortage of such products resulted. The pharmaceutical and medical professions found it impossible to obtain certain botanical and chemical drugs in sufficient quantities to supply either the military or civilian needs. Following that war it was found possible to produce many dyes and chemicals previously obtained from abroad here at a cost about on the level with that of the European products. Consequently the chemical and dye industries survived in this country after that war and we have developed almost complete independence in respect to the majority of such products. Shortages of supplies of some of them for civilian needs are owing largely to the present priorities for military purposes. Again, during the first World War some of the foreign drug- and oil-yielding plants ordinarily grown in Europe were grown successfully here and in other North American countries. Unfortunately, as soon as trade relations were resumed, the competition for botanical drugs from older established sources soon led to the abandonment of the cultivation of most of such plants started during that emergency. Consequently, in the present World War, as early as July 1940 we began to experience a shortage in imports of many European botanical drugs. This was followed in 1941 by a gradual diminution in our imports of botanicals from Asiatic countries.

Among the more important of the essential foreign biological drugs used in this country are cinchona and its alkaloids, quinine and quinidine, opium, digitalis, belladonna, stramonium, hyoscyamus and ergot.

Cinchona and Quinine. Of these the most needed at present, especially by the military forces of the nation engaged in tropical lands, are cinchona and quinine. Our present stock pile of these has been so diminished that institutions having unneeded quantities of quinine and its salts have been called upon to contribute these to the war effort. Very little cinchona has been imported into this country since the Japanese seized the Dutch East Indies from which we obtained about 90 per cent of our normal supplies. While native to South America, that country had not developed cinchona plantations and the wild trees yield bark with a very low percentage of alkaloids. While atabrine and quinacrine have been introduced as synthetics for quinine, they are claimed to be less effective than quinine in combating the malarial organisms and are stated to be useless as prophylactics for malaria.

Belladonna. This country normally imports annually about as much belladonna as can be produced on 350 acres. During 1941 and early 1942 our stock piles of this drug was reduced to the lowest mark in history, owing to the fail-

ure of a huge crop planted in the South in 1941. However, sufficient seed was harvested from the crops grown in 1941 for the Bureau of Plant Industry to establish 100 acres of belladonna during 1942 in each of 5 different states, namely Pennsylvania, Wisconsin, Ohio, Tennessee and Virginia. Two hundred additional acres of belladonna have been planted elsewhere in the United States, including a small acreage in California. It is calculated that the amount of drug grown on 300 to 400 acres will be needed for military purposes entirely.

Stramonium. During 1941 our stock pile of stramonium dwindled and anxiety existed as to future supplies. While this plant is an annual weed found growing wild in many sections of this country and probably so abundant in the wild condition as to supply all of our needs for it, comparatively little of the drug from wild plants has been gathered. We depended largely upon European countries for it. Prior to the war we imported approximately 300,000 lbs. of stramonium a year from Europe and Mexico. During 1941 and 1942 we have been importing large amounts of stramonium from Argentina, some of which has been of low alkaloidal yield. There is sufficient wild growing stramonium all through the Mississippi River Valley and in the Eastern States to supply all needs for this drug. The problem is that of obtaining enough labor to harvest it. Small lots imported from India have shown adulteration with leaves of a *Xanthium* species.

Hyoscyamus. The shortage which existed in 1941 has been relieved this year by the planting of about 100 acres, chiefly in Michigan. Our annual consumption of this drug is about as much as can be grown on 175 acres. Some supplies of *Hyoscyamus muticus* are being received from Egypt but this species is only used for alkaloid manufacture.

Digitalis. As soon as our market supply of this important cardiac tonic drug ran low in 1940 and the price began to rise, hundreds of our people became interested in growing it. While large stands of the wild plant exist in Oregon and Washington and in Nova Scotia the dealers have preferred the cultivated drug since it has the reputation of being more potent. However, considerable of the drug on the market has been gathered from the wild plants grown in the Pacific Northwest. Apparently the wild Nova Scotian source of supply has been overlooked. It is estimated that digitalis will be overproduced in this country during 1942.

Ergot. Prior to the war our supplies of ergot came largely from Spain, Russia, Poland and Danzig. As the war zone extended these sources of supply were cut off and for the past year only sporadic supplies have been coming from Portugal. However, a sufficient stock pile of this drug has been accumulated to take care of our needs for many months hence. In addition domestic ergot of rye and domestic ergot of wheat of excellent quality is being produced on a small commercial scale in Minnesota.

Opium. It is stated that the *Bureau of Narcotics* has a sufficient supply of this drug to take care of our needs if the war is not too prolonged. A reserve seed stock is stated to be on hand and cultivating and processing investigations are well under way.

Castor Oil Seed. Prior to the present war our supplies of this product came largely from India, Brazil, China and Kwantung with smaller amounts from Italy, Mexico and Oklahoma. At present the foreign supply comes chiefly from South America, but this supply is

insufficient for our needs. The paint industry has recently been using considerable castor oil as a substitute for tung oil. *The Bureau of Plant Industry* has 7,500 acres of castor oil plants now under cultivation in regions marginal to cotton and corn states. If this acreage is harvested we should be able to have sufficient castor oil for our needs this year.

Tanning Materials. The chief biological materials used in the tanning industry have been quebracho, hemlock bark, divi divi, nutgalls, oak bark and Osage orange. Our supplies of these from foreign sources have been steadily reduced since 1939. No nutgalls are being imported and extract of quebracho imports began to decline early this year, although recently there has been some increase in the importations of quebracho logs. It may be necessary to substitute American galls and sumac in place of nutgalls as sources of tannin for medicinal purposes. The problem is to get cheap labor, one of the biggest bottlenecks in developing a botanical drug industry in America.

Spices. As long as the trade route remains open to India, we may expect some supplies from abroad of ginger, cardamon, cinnamon, celery seed and coriander. Nutmeg, clove and mace, largely obtained before this war from the East Indies, are no longer obtainable from that source. Limited supplies of those spices are now being received from the West Indies. Some ginger is still coming from Jamaica. Capsicum, formerly obtained from Africa and Japan, is now being produced on an increasing scale in Louisiana.

Insecticides. Prior to our entry into the war we imported huge quantities of pyrethrum flowers from Japan, and Kenya Colony. We are still obtaining supplies from Kenya Colony which are of somewhat higher pyrethrin content than the Japanese flowers. A small commercial acreage of pyrethrum exists in Colorado. There is enough of this insecticide in this country to last through next year. Cube root is being imported from South America, but derris or tuba root, imported in large amounts before the entry of this country into the war from the Federated Malay States and the Philippines, is becoming exceedingly scarce.

Agar. This dried mucilaginous substance obtained from species of *Gelidium, Gracilaria, Eucheuma* and related genera of red algae, found growing in the sea off the eastern coast of Asia and in the Pacific Ocean off the coast of California, has been extensively used in the preparation of culture media for bacteriological and mycological work. It has also been used as a laxative in medicine. We had depended largely upon Japan for our principal supply of this valuable product. California has yielded as much as 35 per cent of the supply annually consumed by this country. Efforts are being made to bolster up that source of supply. No substitute quite as good has yet been found.

ELECTION OF OFFICERS

In past years the February issue has carried the list of candidates for officers of *The National Association of Biology Teachers.* This year, due to the cancellation of the annual meeting, the regular nomination procedure was not possible. The executive board as well as several of the local affiliates, have been at work on the problem. A group of amendments has been proposed, the effect of which would be to solve the problem at the present time and also to take care of similar emergencies in the future. The present by-laws of the Association provide that the representative assembly shall appoint a nominating committee. Since the assembly is a rather large group it is not practical for them to transact this item of business by mail. One of the amendments provides that this duty be transferred to the executive board. The list of amendments as proposed appears on page 112 of this issue.

Building a Microtome*

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Prepared slides of actual tissues offer an excellent means for objectively teaching the biological sciences. Since our school budget did not permit, a factory-built microtome was out of the question. Even the cheapest hand microtomes were too expensive, and were not as good as desired.

With the invaluable aid of a talented student, plans were drawn up for an automatic "slicer" that should work. We had to have rigid parts so we chose aluminum. Its melting point, 657° C. or 1220° F., is low enough for an ordinary forge or gas furnace and it is hard enough to resist reasonable wear. Lead was tried and found much too soft to be serviceable. Wooden patterns were made of each part. These wood templates were then pressed into potter's clay to make an impression. Common red clay can be used, but casting sand is better. The aluminum was heated in a babbitt ladle until fluid and poured into these impressions. The best casts were taken from molds that had been heated thoroughly before the metal was poured into them.

Five different cast pieces make up the machine. Considerable filing and grinding was necessary before the rough casts could be fitted together so as to hold a razor blade and automatically cut paraffin sections nineteen microns thick as fast as the holder could be turned.

About five pounds of aluminum were used, largely metal trimming from the running-board of an old car. One necessary part was a three-inch wheel which was turned out on the manual class wood lathe by using the end of a file as a cutting tool. The other parts were dressed down with an emery stone and flat files.

The whole instrument was built around a ninety-five cent micrometer purchased from a mail order company. The blade-holder turns on its axle and in making one revolution, it turns a "webb" which in turn advances a notched wheel one notch. This wheel fastened to the micrometer spindle causes the spindle to advance a given distance each time the blade makes its section. The axle is a $\frac{3}{8}''$ steel rod that can be made by sawing the valve head from the shaft of an automobile valve. Any sized rod may be used. Springs which fitted the shaft were cut for length and held in place by pins driven tightly into holes drilled in the shafts. Holes were drilled in the head and in the frame where the shafts fitted. This drilling was done on the lathe in order to line up the holes. By putting thirty-two notches in the wheel we could get sections 1/1280 inch or 19 microns in thickness. Double-edged razor blades are held in place between the jaws of the holder, by a bolt which screws in from behind. The holder is held rigidly to the axle by the same means. The threads were easily tapped with a twenty-five cent tap and holder. The razor holder is composed of two parts carefully filed so that they

* Editor's note: It seems desirable to publish this article at this time, even though it describes a project that would not be feasible with the present critical metal shortages. It illustrates what an ingenious teacher can do with a very small capital outlay and may stimulate others to try similar projects not involving critical materials. Mr. Sergeant is at present serving in the United States Army.

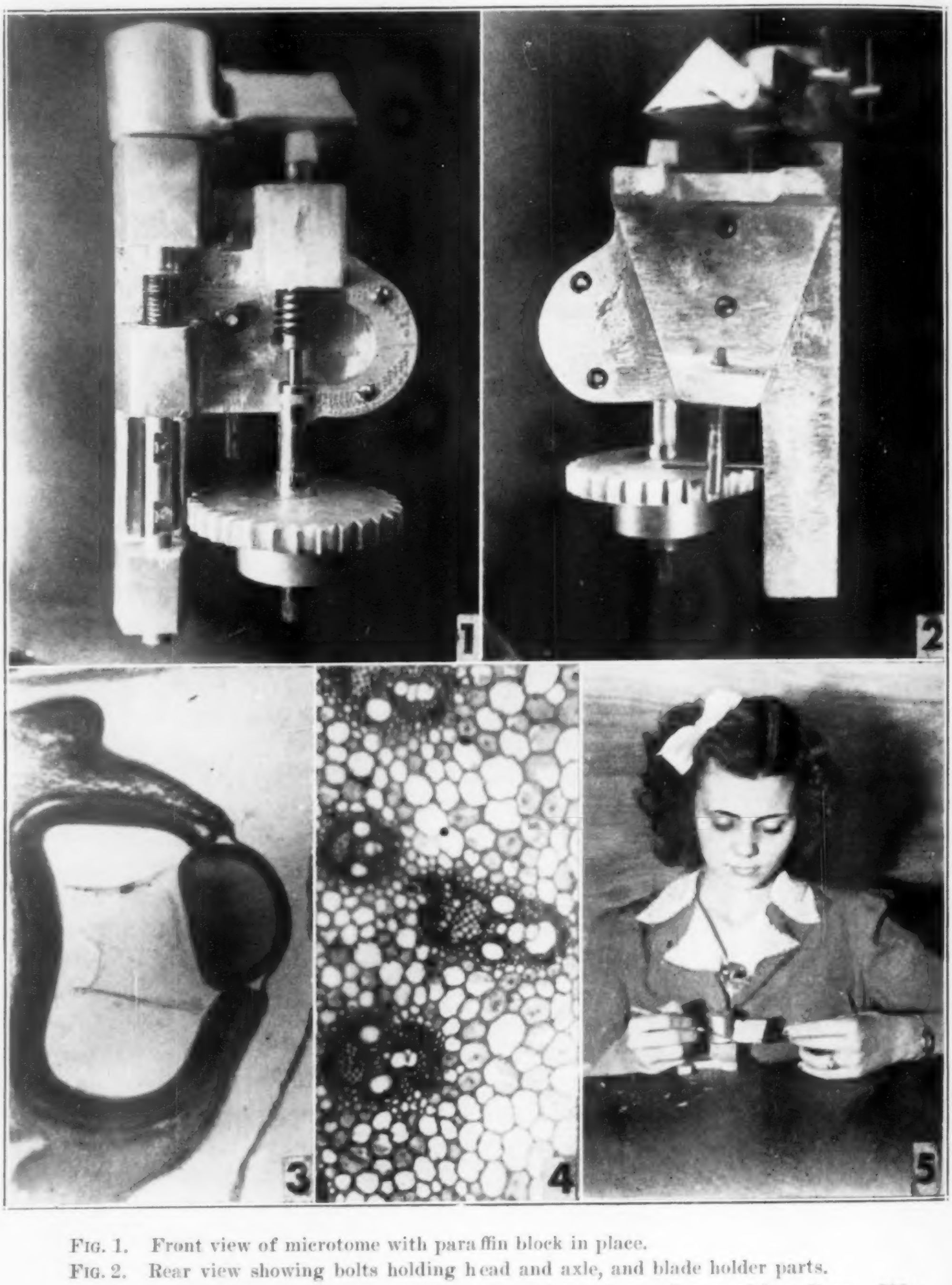

FIG. 1. Front view of microtome with paraffin block in place.
FIG. 2. Rear view showing bolts holding head and axle, and blade holder parts.
FIG. 3. Section through eye region of three-day chick embryo. Lens and lens fibers. 200 ×.
FIG. 4. Section of young corn stem. 200 ×.
FIG. 5. Removing a section to a slide.

meet the blade evenly and firmly. A nail serves as the pin which holds both parts together. A clamp was cast to hold the machine at table level. A factory-made clamp could be bolted to the frame.

This machine has been used in the biology class for cutting tissues of various kinds. Some actual photomicrographs of student made slides are shown in figures 3 and 4. These photographs were taken and processed by students.

The extra teaching value in interest and true understanding on the part of the students more than repay the slight expense and long hours of work necessary in making this machine.

Materials used and money spent are as follows:

1	drill bit 3/16″	.10¢
1	drill bit ⅛″	.10¢
1	drill bit ⅜″	.10¢
10 lb.	potters clay	.15¢
5 lb.	aluminum (pans and car trimming)	
1	steel rod ⅜″ × 9″ (old automobile valve)	
1	steel rod ⅜″ × 3″	
1	metal tap and holder	.25¢
2	bolts ⅛″ × 1″ (to hold micrometer to frame)	
3	bolts to fit threads oftap (found in laboratory junk box)	
2	bolts ⅛″ × ½″ (to hold webb to long axle)	
2	nails (pins to hold springs in place; pin to hold razor holder parts together)	
2	springs (cut from one—donated by student)	
2	bolts 3/16″ × 1″ (to hold clamp to frame)	
1	1″ micrometer	.95¢
3	flat files	.50¢
	Total	$2.15

A Common-Name Classification of Plants and Animals for Beginners

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Students beginning the study of plants and animals in the elementary or high schools should not be subjected to a stream of scientific names, either of species and genera or of larger groups such as orders, classes, or phyla. Scientific nomenclature usually consists of words hard to pronounce and spell, frightening the average young student and dampening his enthusiasm for biology. While scientific names of species and genera are rarely used in beginning courses in biology or science, due to the fact that common names are usually available, scientific names are frequently used for the larger groups because common names are either non-existent or unknown.

Few science teachers would dispute the above statements, and yet no thoroughgoing attempt has been made to solve the problem. The usual "solution" is to omit classification entirely, to use a hodgepodge of common and scientific names, or to use the scientific nomenclature regardless of the consequences. None of these procedures is satisfactory. While we now wish to place less emphasis upon classification than formerly, it has its place, especially where the emphasis is upon natural history, field biology, or nature study. The use of mixed terminology is little more desirable than the consistent use of scientific nomenclature.

This problem has come to my attention from at least three different sources. First, from the students in my general biology course, who even at the college freshman level object to scientific nomenclature. Second, from visits to public

school science classes, where scientific nomenclature was used entirely too freely in several cases. Third, from elementary teachers who were taking my course in elementary science and nature study, and who asked for a system of common-name classification which they could use in their science classes.

Since no such classification was available I constructed the schemes presented in the accompanying tables. I am not setting myself up as an authority on nomenclature, nor am I suggesting that these systems are ready to be put into immediate general use. However, I trust that they will stimulate the formation of some semi-official system of common-name classification which will become widely accepted and used. This would probably fall within the province of a committee appointed by one of the organizations interested in the teaching of biology.

The classification of animals is based upon the widely known and much used phyletic classification of the animal kingdom. The classification of plants is based upon the phyletic system of Schaffner[1] which is unfortunately much less well known and used than the comparable system of classifying animals. It is used here, not only because it lends itself more readily to common-name equivalents than the well known four-division system, but also because it is much sounder scientifically. The first eight phyla are *Thallophyta*, the *Bryophyta* are the same in both systems, phyla ten to twelve are *Pteridophyta*, and the remaining three phyla are *Spermatophyta*.

The classification generally does not extend beyond phyla, as this is usually a fine enough degree of classification for beginners. However, the *Anthophyta* (Angiosperms), *Arthropoda*, and *Chordata* are such large and important phyla that their classes have been included, though the first three sub-phyla of the *Chordata* have been omitted as being of little significance to beginners, as have several of the small animal phyla and insect orders. Since the insects are so important and constitute the majority of all species they have been classified to orders. The only other class in which the orders might be significant to beginners is the mammals, but they are not outlined here.

Whenever an established common name was available and not too hard to pronounce or spell it was used, even though it is merely a variation of the scientific name. In the *Schizophyta*, *Bryophyta*, *Odonata*, and *Lepidoptera* two common names are required to cover the group, this being considered preferable to synthesizing a single name.

TABLE I

A Common-Name Classification of Plants

1. *Schizophyta*	Bacteria Blue-green Algae
2. *Myxophyta*	Slime Molds
3. *Zygophyta*[2]	Diatoms
4. *Gonidiophyta*	Green Algae
5. *Phaeophyta*	Brown Algae
6. *Rhodophyta*	Red Algae
7. *Charophyta*	Stoneworts
8. *Mycophyta*	Fungi
9. *Bryophyta*	Liverworts Mosses
10. *Ptenophyta*	Ferns
11. *Calamophyta*	Horsetails
12. *Lepidophyta*	Clubmosses
13. *Cycadophyta*	Cycads
14. *Strobilophyta*	Conifers
15. *Anthophyta*	Fruiters
a. *Monocotylae*	Monocots
b. *Dicotylae*	Dicots

[1] Schaffner, J. H. *Phylogenetic Taxonomy of Plants.* Quarterly Review of Biology, 9: 129–160. 1934.

[2] This phylum contains also some green algae and the following phylum contains also some simple fungi, but it seems best to disregard these complications in a scheme of classification for beginners.

When it was necessary to synthesize common names they were based on either a translation of the scientific name or on some outstanding and universal distinguishing characteristic of the group. The following list of the synthetic names illustrates this: fruiters, prickleys, spineys, sectionworms, jointies, manylegs, eightlegs, straightwings, samewings, nervewings, twowings, and thinwings. These names will sound strange and childish to biologists, but they are little more juvenile than such terms as "horsetails," "sponges," "flatworms," "bristletails," and "springtails" which are now in common use. They are not intended primarily for adult biologists, and will sound more appropriate with continued use. A common name composed of two words should be contracted into one or at least hyphenated, except for such terms as "Green Algae" and "True Lice." This is particularly important in names of insect orders including the word "fly" in order to distinguish these insects from the true flies of the order *Diptera*.

While it will be difficult to secure wide usage of synthetic names such as the ones proposed here, or even other better ones which someone more adept at inventing terms may suggest, the process would be greatly accelerated if authors writing new elementary biology books would incorporate these terms in their manuscripts. There would be abundant opportunity for such use, entirely aside from discussions dealing primarily with classification.

TABLE II

A Common-Name Classification of Animals

1. *Protozoa*	Protozoa
2. *Porifera*	Sponges
3. *Coelenterata*	Prickleys
4. *Platyhelminthes*	Flatworms
5. *Nemathelminthes*	Roundworms
6. *Trochelminthes*	Rotifers
7. *Annelida*	Sectionworms
8. *Echinodermata*	Spineys
9. *Mollusca*	Molluscs
10. *Arthropoda*	Jointies
a. *Crustacea*	Crustaceans
b. *Myriapoda*	Manylegs
c. *Hexapoda*	Insects
d. *Arachnida*	Eightlegs
11. *Chordata*	Chordates
Vertebrata	Vertebrates
a. *Pisces*	Fish
b. *Amphibia*	Amphibians
c. *Repilia*	Reptiles
d. *Aves*	Birds
e. *Mammalia*	Mammals

TABLE III

A Common-Name Classification of Insects

1. *Thysanura*	Bristletails (Silverfish)
2. *Collembola*	Springtails
3. *Plecoptera*	Stoneflies
4. *Ephemerida*	Mayflies
5. *Odonata*	Dragonflies Damselflies
6. *Isoptera*	Termites
7. *Orthoptera*	Straightwings (Cockroaches, Praying Mantes, Walking-sticks, Grasshoppers, Crickets, Katydids)
8. *Dermaptera*	Earwigs
9. *Coleoptera*	Beetles (includes Weevils)
10. *Thysanoptera*	Thrips
11. *Corrodentia*	Book Lice
12. *Mallophaga*	Biting Lice
13. *Anoplura*	True Lice
14. *Hemiptera*	Bugs
15. *Homoptera*	Samewings (Cicadas, Frog-hoppers, Tree-hoppers, Leaf-hoppers, Latern-flies, Plant Lice, White-flies, Scale Insects, Mealy-bugs, Bark Lice)
16. *Neuroptera*	Nervewings
17. *Trichoptera*	Caddiceflies
18. *Lepidoptera*	Butterflies Moths
19. *Mecoptera*	Scorpionflies
20. *Diptera*	Twowings (True Flies, Midges, Gnats, Mosquitoes)
21. *Siphonaptera*	Fleas
22. *Hymenoptera*	Thinwings (Bees, Wasps, Hornets, Ants, Sawflies, Ichneumons)

President's Page

In compliance with the request of the Office of Defense Transportation, the Executive Committee of the American Association for the Advancement of Science voted to postpone the New York meeting scheduled for the week of December 28, 1942. Inasmuch as the *National Association of Biology Teachers* is an affiliate of the A.A.A.S., our annual meeting was also postponed. Our constitution provides that we hold our annual meeting during their winter meetings, consequently, when and if the A.A.A.S. hold their postponed meetings we will also hold ours. As yet we have heard of no plans to hold the meeting in the immediate future.

Did you know that our Journal has subscribers in the following countries: Canada, Mexico, Jamaica, Brazil, Costa Rica, and Australia? Also it goes to every state in the union, to Alaska and to Hawaii. We think this is doing well for a five year old enterprise.

Most magazines and newspapers have raised their subscription price. We have put it off just as long as we possibly could. The only way it can be done is by an amendment to the constitution. At the December meeting of the Chicago Biology Round Table it was moved to amend Article IV, Section 4, to read: "The executive board shall be empowered to adjust the amount of membership dues as necessary to cover the cost of the Journal and the operation of the Association. This membership includes subscription to the Official Journal." After two months notice in the Journal the Representative Assembly can vote on the amendment at an Annual Meeting or Special Meeting. The Representative Assembly consists of the officers of the association, members of the editorial board, members of the advisory board, all past presidents, delegates from each affiliated local, and chairmen of all standing committees. It is hoped that a special meeting can be held in March or April, probably in Chicago, to act on the above amendment and to transact other business.

On November 20, 1942, our treasurer, Mr. Houdek, reported as follows:

Funds on hand: Bank balance, undeposited checks, etc.			$178.74
Memberships due for 1942–43 (approx).			900.00
Advertising due from 1941–42			25.00
Advertising for 1942–43			?
			$1103.74
Debts outstanding:			
Science Press	April	$307.45	
	May	278.77	
	Oct.	275.31	
Various officers' expenses		?	
Total		$861.53	

President's additions and inclusions as of Jan. 9, 1943.

Funds on hand			$178.74
Due from members			900.00
Advertising from 41–42			25 00
Advertising Estimate 42–43			1000.00
Estimated Deficit July 1			832.79
			$2936.53
Debts outstanding and estimated:			
Science Press	Apr. 42	$307.45	
	May 42	278.77	
	Oct. 42	275.31	
Seven issues @ 275		1925 00	
Officers		150.00	
		$2936.53	

It is your president's personal belief that $1.50 per year would enable us to make up our deficit and give us a working balance in a year or two. Then, when time gets more normal, and we get more advertising, also many more members, we can lower the dues back to the original $1.00.

This is a challenge to all our members and affiliated locals. More members will make a stronger organization. Adver-

tisers will be more anxious to avail themselves of the magazine and we can give all more and better esrvices. Dr. Beltran of Mexico just sent in four renewals and one new membership. Can't more of us do likewise?

I am now awaiting a motion from a member of the Executive Board that a nominating committee be appointed. Then, with a favorable vote on the motion, the committee will be appointed, nominations made, and an election held by ballot as usual.

Do you like the new *By The Way* column in the Journal? I do. Let's deluge Dr. Breukelman with contributions to help it along.

Sincerely,
M. A. Russell

THE RELATIVE IMPORTANCE OF BIOLOGY AS A HIGH SCHOOL SUBJECT

Subjects in the high school curriculum vary in the degree of their relative importance. Theoretically, they may seem to be of nearly equal value, but as far as practical value is concerned they may vary considerably in importance.

It is difficult to determine what subject is of most value to students as a whole. In any case, biology ranks high when compared with all other subjects. The inherent nature of the subject makes this true. No matter what vocation in life one may choose, he is always confronted with the fact that he is dealing with living things, with people, the biological aspect of his vocation. Biology, then, regardless of the one who may teach it, becomes because of its content a most important subject. Personally, I think biology is as important as any subject and should be made compulsory for all high school students.

The foregoing is in keeping with the trend of modern education away from the three R's of a few generations back. The general trend is to shift the emphasis from subject matter itself to the preparation which the subject gives the individual to the changing social order in which he lives. In this shifting of emphasis biology becomes decidedly one of the major subjects not only in the field of science but in the entire high school course.

It has been generally considered that the social sciences are the principal aids in producing well-rounded citizens. It is true, that they should be important in this respect, but from the unbiased viewpoint of the biologist, they are by no means the exclusive factor. It is the biological sciences which provide the natural foundation of the science and art of right living which human welfare demands. Biology not only gives the student information and knowledge about living things but should develop scientific thinking methods and attitudes toward ourselves and our environment. It becomes even more important as a high school subject in the present emergency because it will be the knowledge and application of biological principles, especially those relating to disease, the successful growth of food crops, insect control and many other related subjects which will contribute most to a victorious termination of the present crisis and the rehabilitation which is to follow.

The best citizen should be the one who is properly educated, the well-rounded citizen. This does not necessarily mean the one who has the greatest store of information. It means the one who not only knows but who has a reason for the knowledge he possesses. In this respect biology is one of the few subjects which adds to the general culture by increasing the number of things in which we are interested and about which we should have information. Properly taught, biology because of the content of its sub-

ject matter brings out the great principles which underlie all life.

Civilization at best is but an artificial man-made affair conforming to certain standards which vary as knowledge increases. It is far from perfect. In working out or eliminating the imperfections in civilization most of our problems are biological. The more fully, therefore, we understand what we are and the reason for our being so, the better will be the chance of progress. Biology not only presents these laws but does as much or more than any other high school subject in clarifying them.

In conclusion, it may be said that one of the fundamental aims of our educational system is to prepare the individual as a citizen and a cooperating member of society. Our educational system is successful only to the degree to which it teaches the individual to adapt himself to his particular environment. Those subjects which contribute most to such preparation are relatively more important than those that do not. Since biology does contribute largely in bringing about changes that make for better citizenship, its value in the high school curriculum can scarcely be overestimated.

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PROPOSED AMENDMENTS

The Detroit Biology Club has proposed the following amendments to the By-Laws of *The National Association of Biology Teachers:*

1. To the second sentence of Article I, Section 2, add, "except as provided in Article II, Section 6." The sentence would then read: "The president-elect shall succeed to the office of president the following year, except as provided in Article II, Section 6." (See change no. 3, below.)

2. In Article II, Section 1, substitute "Executive Board" for "Representative Assembly." This change would give to the executive board the duty of appointing the nominating committee.

3. To Article II, add Section 6, as follows: "In an emergency, when the Representative Assembly so wishes, officers may be held over for a period of time designated by the Assembly, past the regular time for election. In such event, the postponed election shall be held in time for the newly-elected officers to take office before the beginning of the next fiscal year." This change would assure the Association of having a full set of officers even though an emergency might interfere with the normal procedures of the annual meeting and the regular election of officers.

The procedure for amending the by-laws is the same as that for amending the constitution. It was outlined in the January number, page 95.

THE FORTUNE SURVEY

The recent *Fortune Survey* of American high school opinion should interest all who teach adolescents, especially biology teachers. It presents a well organized cross section of what high school boys and girls think of the world in which they live and of their part in it. Reprints of the survey are available without cost; write to the General Manager, Fortune Magazine, Time and Life Building, Rockefeller Center, New York City, and ask for the November–December *Fortune Survey of Public Opinion.*

REVIEW OF EDUCATIONAL RESEARCH

The 92 page October issue of the *Review of Educational Research* is devoted to the natural sciences and mathematics. There are 9 chapters, each with an extensive bibliography. Biology teachers will find special interest in the chapters on the teaching of science in the upper grades, the teaching of science in senior high school and junior college, and teacher education in science and mathematics. The index is adequate and well organized. For information write to the American Educational Research Association, 1201 Sixteenth Street, Washington, D. C.

THE MANPOWER PROBLEM

The Cooperative Committee on Science Teaching has prepared a detailed statement on this subject, and its full report is being published in the February issue of *School Science and Mathematics.* The pre-induction courses outlined by the War Department are given major consideration in this report, but non-physical science courses (mathematics, biology, chemistry) are also re-

viewed in their relation to pre-induction training, to the broader manpower problem, and to wartime pressures and demands on the secondary schools. Reprints of this report can be obtained free by writing to Dr. Robert J. Havighurst, chairman, The University of Chicago.

ANNUAL MEETING OF THE KANSAS ASSOCIATION

The annual meeting of The Kansas Association of Biology Teachers was held in the Grill Room of the Hotel Lassen, Wichita, Kansas, November 7, 1942. The business session was in charge of President Ira M. Hassler; President-elect E. Paul Lessig presided over the program session. The program, arranged by President Hassler, was as follows:

Practical Methods of Preserving and Mounting Specimens for Use in Class and Museum—Harry H. Hall, Pittsburg, Kansas.

Making and Using Colored Slides for Laboratory Aids—John Breukelman, Emporia, Kansas.

Questions and Discussion.

The officers for the ensuing year are as follows:

President: E. Paul Lessig, Wellington High School. (Automatically changing from President-elect to President.)

President-elect: Roy Metcalf, Wichita High School North.

Vice President: S. B. Griswold, Newton High School.

Secretary-Treasurer: Ruth Heil, Wichita High School East.

BY THE WAY

A Lump Of Frozen Earth containing plant roots, brought into the laboratory and allowed to warm up gradually, will demonstrate better than pages of textbook material that many species of animals are present in the soil, in dormant form, even at temperatures far below the freezing point.

Insect Wings can be mounted in useful and attractive form by fastening them between 2 × 2 inch glass plates, thus making slides which may be projected on the screen or examined with a lens or low power microscope. The slides may be held together with any kind of binding tape. Such wings as grasshopper, beetle, etc., should be carefully "unfolded" before fastening permanently.

Seeds and Insect Galls may be collected throughout the winter months; biological activity usually starts soon after these are brought into the temperature of the classroom.

Cocoons of various *Lepidoptera,* as well as dormant forms of other insects, can be found in the crevices of bark, under loose bark, and in stumps and fallen logs. These should be brought to indoor temperatures gradually or they will be killed. Woods near streams or bodies of water are richer in such specimens than are upland woods. Deciduous woods are richer than coniferous.

THE BIOLOGY PRACTICAL EXAMINATION

The practical examination and its use in biology is not a new academic procedure but is not utilized to its fullest extent because many teachers consider it a time-consuming process. We use it extensively at Bethany College without throwing our laboratory sections out of gear. We have about one hundred students, most of them freshmen, taking the course in general biology and believe that we have reduced the labor necessary for the practical examination to a minimum.

On account of limited laboratory space it is necessary that we have four two-hour periods each week in order that all may put in the required number of hours. When giving the practical, the following procedure is used; the test is announced at least a week in advance so that all students may study and be prepared. It is a heart-warming experience to a biology teacher to see a laboratory crowded with first-year students doing extra work in preparation for the practical.

The day of the examination arrives, and here is the manner in which we handle it: regular directions for the day's work are given, with the strict injunction that no reviewing is to be done. Half of the students in the laboratory

are then sent to the classroom where they are assigned alternate chairs. Each is supplied with a piece of paper on which he is asked to place in a column numbers corresponding to the number of questions about to be asked on this part of the examination. Suppose on this particular day the frog is the subject for test; the examiner announces that question number one will be the structure shown to each student. Usually the examiner places a dissecting needle in the structure (in this case it might be the spleen) and each student is given a look as he remains seated. He then writes the name of the structure after the appropriate number on his paper. Ordinarily fifteen or more such questions are asked. These folks are then sent back to the laboratory to go on with the regular work of the day and the remaining students are brought in and the same questions are asked. The questions are varied for the other laboratory sections throughout the week.

When microscope slides are used for the examination, the entire group present is tested at the same time. All of our microscopes have the high power ocular equipped with horsehair pointers. The student is told that question number one is such and such a structure, and is given about thirty seconds to put the end of the pointer in or on that particular group of cells. Assistants then pass along the tables, checking each scope, keeping tabular results of correct and incorrect pointer settings.

A microprojector set up in a darkened classroom has also been utilized for the slide test but its limitations make the test described above easier to handle and results in general were not so good as those secured with the individual microscopes.

It is hoped that this little article may prompt some biology teacher to try the practical examination and note its gratifying results.

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The Relation of the Study of Biology to Biological Misconceptions

MELVIN W. BARNES
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One of the frequently announced objectives of introductory courses in biology is the elimination of misconceptions and superstitions from the minds of students. Thus, a certain course in biology is concerned with "common prejudices in the field of health and disease"; another aims at the "development of a trait of skepticism as opposed to credulity." In providing practice in the use of the scientific method, teachers and learners commonly devote considerable effort to the examination of superstitions, advertising claims, and popular notions about the operations of nature.

The present study is a report of an investigation conducted in a survey course in a university in which students having

had a course in biology in high school are compared with students not having had such a course with respect to beliefs about certain biological phenomena. The students whose records provide the data herein reported enrolled in the General Division of the University of Illinois, one class in September 1940, the other in September 1941.

At the beginning of each year the entering students were given a test consisting of 100 items designed to discover what popular misconceptions they held. A portion of this test follows:

DIRECTIONS

If a statement is true, encircle the letter "T" in the margin.

If a statement is false, encircle the "F."

If you have no opinion, do not make any mark.

1. T F Men have one less rib than women.
2. T F Decayed teeth can be restored by eating citrus fruits.
3. T F The skin can be nourished by applying a skin "food" to the surface.
4. T F During pregnancy the mother's blood mixes with that of the child.
5. T F Thunder may cause milk to sour.
6. T F Milk and meat may safely be eaten at the same meal.
7. T F Most illness is caused by dislocations of the spinal bones.
8. T F Cancer is caused by excessive eating of tomatoes.
9. T F Milk snakes have been known to milk cows.
10. T F Golden-rod is very important as a hay-fever plant.
11. T F If placed in water, a horsehair will become a living horse-hair snake.
12. T F The number of rattles on a rattlesnake accurately indicates its age.
13. T F A snake will die only after sundown.
14. T F Nerve impulses travel with the speed of light.
15. T F Seeds found in King Tut's tomb germinated after thousands of years of dormancy.
16. T F Water rises in a tree in the form of vapor.
17. T F Birthmarks are often caused by frights experienced by the mother during pregnancy.
18. T F Healthy persons have no bacteria in their intestinal tracts.
19. T F A tendency toward baldness is inherited.
20. T F Artificial light can be as good for vision as natural light.
21. T F Oysters ought to be eaten only in the months having an "r" in their names.
22. T F Going without a hat will usually stop falling hair.
23. T F Identical twins can be of opposite sexes.
24. T F Dandruff can be removed permanently.
25. T F Blood tests are useful in determining paternity.
26. T F Well-educated people can have feeble-minded children.
27. T F Pasteurization of milk seriously modifies the food elements of milk.
28. T F If water is perfectly clear when held up to sunlight, it is safe to drink.
29. T F Dogs howl when a human death occurs nearby.
30. T F By natural instinct an animal always knows what food is best for him.
31. T F Frost will occur within six weeks after the first katydid sings.
32. T F By reading the palm of a person, some can foretell the future.
33. T F A red string worn about the neck will prevent nose-bleed.
34. T F The mourning of a dove is an omen of death.
35. T F If a thrush sings through the day it will rain.
36. T F If a rooster crows in the middle of the night, the weather will change.
37. T F If a dog licks a wound, it will heal more quickly.
38. T F The toad carries a jewel in its head.
39. T F If a forked willow branch turns in the hands, water is in the ground at that place.
40. T F If rats leave a ship before it puts out to sea, that ship will be lost.
41. T F If a cricket sings in the house, good luck is to follow.
42. T F The wearing of a rattlesnake skin will keep away disease.

43. T F If a bat comes into the room, it is a sign of death.
44. T F Bats like to become entangled in human hair.
45. T F A nutshell hung around the neck will prevent disease.

The instructions were to mark a statement believed true or false by encircling accordingly either the letter T or F and to leave unmarked the statements about which the student had no opinion. Scoring was done in terms of correct responses. The test was constructed by the five instructors in charge of the course. Its reliability obtained by the use of a Kuder-Richardson formula was .78.

In Table I is presented the comparative performances of students having had high school biology and those having had no high school biology. Test results with the *ACE Psychological Examination* indicate that in both years the groups compare closely in intelligence. In 1940, the mean score of the biology group was 108.02; that of the non-biology group, 108.23. The variability of the two groups was also similar, a standard deviation of 26.07 being found for the biology group and a standard deviation of 26.26 for the non-biology group. In 1941, also, the groups were not significantly different in performance on the ACE Test.

The results in both years show a difference in favor of the students who have had a course in biology in high school. Only in the instance of the 1941 results, however, is the difference large enough to be said to be statistically significant.

Table I

	Students having a course in biology in high school	Students not having a course in biology in high school	Ratio of difference to probable error of difference
Students entering the university in 1940			
Number of students	54	46	
Mean score	51.79	48.18	2.6
Standard deviation	9.99	10.69	
Students entering the university in 1941			
Number of students	41	37	
Mean score	54.88	48.82	4.4
Standard deviation	13.02	18.07	

Your Classroom Can Be A Museum

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A biology classroom should never lack objective materials because a school cannot afford expensive biological supplies. Better "brands" of biology are often taught with student-made equipment. In this case the teacher and the students share alike in the joy of their accomplishments. An "empty" classroom probably indicates that the course is founded upon passive textbook humdrum, that the teacher lacks energy and initiative, and that the students lack the real interest which results in active participation. A classroom reflects the kind of teaching that goes on within it.

Since the study of biology is the study of life it is of necessity intimately associated with phenomena such as chemistry, physics, electricity, and light. Students have specific interests in these subjects, which require only the proper biological "hookup" to stimulate active

interest in biology. Probably no other course in our secondary schools is so rich in opportunities for active participation by both teachers and students as biology. Herein lies the opportunity of the gifted teacher to plan the greatest good for the greatest number, founded upon associated and interrelated materials, and suited to individual needs and interests. To work effectively it must be a plan in which the most gifted and the least gifted may contribute according to ability; it must provide unlimited suggestion for a large variety of activities, and above all the final results must be objective.

A Natural Science Museum in the biology classroom can be the ultimate objective of such a plan. Many types of interests may be utilized in building a museum, in fact the variety may become so great that almost everyone of an entire class may contribute something to the cooperative plan as a whole.

How To Start A Museum

Every class in biology has within itself the potential possibility to start and develop a small Museum of Natural History. This potential museum may take the form of latent energy among the students ready to be released through proper stimuli under the direction of the teacher to make collections, to mount and to classify.

It is quite possible that large numbers of students have scattered among their homes enough interesting specimens to start the nucleus for a worth while museum in the classroom. Since the glamor of interesting specimens in the home usually wears off as they become old and dusty, many parents are glad to part with their treasures when they know they are to serve a useful purpose.

To accomplish his purpose a teacher must first "sell" the idea of a museum to his students with a vivid word picture of what he intends to accomplish through the co-operation of all his students. Since a student may not know what his parents have stored in the attic or cellar it is usually good strategy to begin to search the grounds most familiar to him, *i.e.*, his home. In this project he will probably obtain the co-operation of his parents who may help to carry the hunt to a successful conclusion.

When a classroom museum is started from "scratch" the following list will prove helpful to supply the initial material for a quick start, namely:

1. Old shadow boxes, or good mounting boxes of any kind.
2. Picture frames with a wooden finish.
3. Window glass, 8×10 inches or larger.
4. Stuffed birds or animals.
5. Potted plants of any kind.
6. Water plants for aquaria.
7. Cocoons or insects in good condition.
8. Wild fish such as sunfish, minnows, bullheads or carp.
10. Straight-sided pickle jars or mayonnaise jars, quart or pint sizes.
11. Fish bowls, large jars or aquariums.
12. Industrial exhibits of a biological nature.
13. National Geographics on plants or animals.
14. Books of any kind related to biology, such as tree or flower guides; books on botany, zoology, health, etc.
15. Cigar boxes, for mounting insects and storing materials.

Constant suggestion is the secret for success in student collecting. Like adults, high school students forget, and must be constantly reminded.

If the teacher has "sold" the museum idea, and if he is lucky with the above list he may find that what started out

to be a class project may have developed into a community project. Among the parents there are often nature enthusiasts who welcome the opportunity to contribute. The materials that may be collected in the above manner may surpass a teacher's wildest imagination.

How To Develop The Museum

Co-operation should be constantly emphasized as a means of accomplishing results that could not be acquired by any one individual such as for example:

1. Co-operative planning.
2. Co-operative collecting of working materials.
3. Co-operative working of special interests such as art and woodwork to produce a finished product.

Repetition should be used to offer additional suggestions for activities that may strike all types of individuals. All projects should be carried through to their logical conclusions, once they have been started. A student should not be allowed to give up once he has selected and started a given piece of work. In this connection it is often wise to put a good student and a poor student on more difficult projects. Since the poorer student will shine in some of the reflected glory of his partner he will learn a great deal of application which could not be otherwise self-imposed.

Every effort should be made to use all types of abilities. Those interested in art should be encouraged to use their talents in painting still life, constructing dioramas, modeling and labeling materials. The shop boy who probably is not artistic may share in the glory of a finished product by making a wooden case for a diorama. Many students with an artistic tendency are especially gifted in manipulation and arrangement of materials. Such students can mount materials successfully, and make good dissections under the direction of the teacher. Finally, those who are not gifted in any other way are often good collectors. These people play their part by keeping up the supply of live material in the laboratory. Of course, collecting should not be done merely for the sake of collecting. Everything should eventually be classified and mounted when possible so that it may be used in classroom work. Nothing should be wasted.

Thus, the laborer, the mechanic, the architect and the artist may combine in school as in real life to turn out a worth while product.

Organization

Organization is the secret of successful teaching in our modern schools with their mass education methods. It is especially true in laboratory courses such as biology where materials must be used each day with a minimum of loss and breakage. Such materials should be classified, grouped and filed so that they may be found in a definite place on a moment's notice, and with a minimum of uncertainty and confusion. Definiteness and system are reflected in neatness and order in the classroom because many students will take pride in doing their share of the work. Pride in the classroom itself will lead to greater enthusiasm about the subject matter with a desire to do additional work beyond the original assignments. When a student can point to a piece of work and say, "I did that, that is mine!" he immediately becomes an integral part of the classroom setup.

Summary

1. It is not enough merely to suggest that students start a museum in the laboratory or classroom. The idea must be popularized and "sold" to them by the teacher.

2. Constant repetition of the museum idea with unlimited suggestions for projects will finally bring about activity.

3. The teacher must organize all types of abilities so that everyone may contribute something to the general plan as a whole.

4. As soon as the museum becomes fairly well established classroom organization in the handling of materials becomes a prime factor for efficient teaching.

Biological Briefs

TEALE, EDWIN WAY. *Children of the Sun.* Nature Magazine 35: 427–429; 444. October, 1942.

The activities of insects are in many ways correlated with temperature. Ants run much more quickly as the temperature rises, and decrease their rate of progress immediately when passing through a shady spot. Their speed, as well as the rapidity of the song of the snowy tree cricket, may serve as an accurate substitute for a thermometer. Certain butterflies and grasshoppers fly only when a certain temperature level has been reached, and bees are immobilized below 45° F. Although it is phototropism which attracts moths and other night-fliers to lights, this activity is greatly increased between 80° and 90°. The speed of cockroach growth is markedly influenced by temperature, and adults seek out homes where the range is between 70° and 80°. During the warm summer months, aphids reproduce asexually and only females exist; with the drop in temperature as fall approaches, males appear and the time between generations increases. The eggs of short-horned grasshoppers require winter cold to break their dormancy, and fail to develop normally if kept warm throughout the winter.

STANFORD, E. E. *Plants in a World at War.* Nature Magazine 35: 456–462; 498; 500. November, 1942.

Rubber is not the only plant product whose source of supply has been closed to us. The barks of many native trees are now being tested to replace a variety of imports from which leather-tanning extracts are obtained. The few California cork oaks have been stripped and more trees are being planted, while the potentialities of the barks of several firs for granulated cork are being investigated. Fibers from redwood bark may be adapted for insulation and for admixture with textile fibers. Of all textile and cordage materials, we are self-sufficient in cotton and rayon alone. A limited amount of fiber flax is produced in Oregon. The available supply of Manila hemp is carefully husbanded, and wherever possible sisal and cotton are substituted. Domestic hemp production is being emphasized. Milkweed floss may serve as a partial substitute for kapok. We need larger plantings of bush flax for linseed oil to substitute for tung, while Brazilian palm-oils and gums from pines may also help our drying-oil problem. We may manage to raise castor beans to replace imports for medicine, paints, leather finishing, and calico printing. Cottonseed, soybeans, and peanuts are our most important source of food-oils, and the first two of these, together with South American palm oils, must serve to replace coconut oil for soap and glycerine.

RUTH S. STEIN

Books

REESE, ALBERT M. *Outlines of Economic Zoology.* 4th edition. The Blakiston Company, Philadelphia. xii + 359 pp. illus. 1942. $3.25.

Opening with a discussion of the intestinal amebas of man, and closing with comments of the uses of whale ribs and porpoise leather, *Outlines of Economic Zoology* is a text-book for a general survey course in its field or a supplementary source for the traditional courses in biology and zoology.

For each phylum there is a brief review of classification. Appropriately the author devotes relatively more space to forms for which there is less literature ordinarily available. For example, the discussion on alligators takes seven pages, while all of the insects take only 25. A bibliography of 348 references is arranged by groups.

While there are occasional quotations from more technical reports, the vocabulary is no more difficult than that of the average elementary text in biology. A number of our students using the book for special report topics, have shown reasonable mastery of the ideas. Comparing it with his own biology text one high school sophomore said, "It has more in it that you want to know."

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BURDICK, A. J. and DUDLESTON, J. J. *Visualized General Biology.* Oxford Book Co., New York. 354 pp. 1942. $.99.

This is a text that conforms to the General Biology Syllabus of New York. It contains eleven units covering such topics as Classification, Evolution, Ecology, Physiology, Heredity, Reproduction, Health, and Anthropology.

All visual supplementation is in the form of line cuts of an acceptable construction. Typography, cover and layout are unadorned, simple businesslike efforts. There are questions at the end of the chapter. The book contains an index, review questions and former New York State biology regents examinations.

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KLUVER, HEINRICH (editor), *Visual Mechanisms.* Biological Symposia, Vol. VII. The Jaques Cattell Press, Lancaster, Pa. 322 pp. 1942. $3.50.

The symposium on *Visual Mechanisms* is a collaboration of twelve chapters by fifteen authors. Each author is a noted investigator and an authority in his field. Topics discussed are as follows: (1) Energy Relations in Vision, (2) The Photo-chemistry of Visual Purple, (3) Visual Systems and the Vitamins A, (4) Anoxia in Relation to the Visual System, (5) Visual Sensation and Its Dependence on the Neurophysiolgy of the Optic Pathway, (6) Alpha Waves in Relation to Structures Involved in Vision, (7) Recent Evidence for Neural Mechanisms in Vision Leading to a General Theory of Sensory Acuity, (8) The Functional Organization of the Occipital Lobe, (9) Anatomy of the Retina, (10) The Visual Cells and Their History, (11) Functional Significance of the Geniculo-Striate System, (12) The Problem of Cerebral Organization in Vision.

Of special practical interest to the biology teacher are chapters three and ten. Discussed in chapter three is the relation of vitamin A to the visual systems of both the vertebrates and invertebrates. Visual cells and their history of development in various groups of vertebrates is excellently and simply discussed. Tables and diagrams accompany the discussion.

There are 75 illustrations, including curves, diagrams, photomicrographs, and tables. In addition there is an extensive bibliography accompanying each chapter and citing recent publications of numerous authorities. There is no index. With rare exceptions the book in its entirety is designed to yield information to the average biologist or biology teacher and undoubtedly contains one of the best compiled lists of references relating to investigations in the field of visual mechanisms.

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PAYNE, SISTER MARY ANTHONY, O.S.B., *Biology—Season by Season.* American Book Company, New York. xii + 675 pp. illus. 1942. $2.00.

This excellent text is written from the standpoint of the Catholic secondary schools. It is only the second one of its kind, according to a statement in the foreword. The book is in three main divisions: Life in Autumn, 6 units, Life in Winter, 5 units, Life in Spring, 4 units. Each unit consists of from 2 to 6 problems, the latter forming the separate chapters. Each problem is followed by a list of scientific terms, questions and applications, suggested activities, and self-testing exercises. Each unit is followed by suggested projects based on the unit, a review of the unit material, and a list of references, including books, periodicals, pamphlets and bulletins. There are almost 400 illustrations, about 25 of them page size, of which four are full color reproductions of Kodachromes. The photographic illustrations are unusually good from the pictorial standpoint and are exceptionally well selected from the teaching standpoint. The pronouncing glossary includes about 800 terms. The index is comprehensive and well arranged. The format and general arrangement are such as make for easy reading; the paper and binding are attractive and durable.

This book is presumably sound in its presentation of Catholic philosophy and religious implications, although the reviewer does not feel capable of judging this point. He does consider it important to emphasize that the Catholic implications have been worked in without any sacrifice of scientific accuracy or pedagogical soundness. *Biology—Season by Season* will set a high standard for Catholic biology textbooks for many years to come and should do much toward the extension of the subject of biology in Catholic schools.

JOHN BREUKELMAN